

## Original Research Article

# Comparison of EEG changes in neonatal period and three months of age in patients with history of neonatal seizure

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## ABSTRACT

**Background:** The prevalence of neonatal seizure in term neonates is 3 per 1000 births, but in preterm newborns is 50 per 1000 births. Babies who have seizures are at high risk of death or neurological disabilities. Seizure is often the first sign of neonatal dysfunction and may be effective in long-term prognosis. EEG is the only available method for the diagnosis of seizures in neonates. The aim of this study was to Comparison of EEG changes in neonatal period and three months of age in patients with history of neonatal seizure. Therefore, authors compared EEG changes in the first EEG infant seizure with 3 months of age in newborns who referred to the Aristotelian hospital in Bouali Hospital.

**Methods:** The present study is a cross-sectional descriptive analytical method. In this study, neonates referred to Ardabil Boali Hospital, EEG, were screened for seizure and EEG was monitored 3 months later and the results were evaluated. Finally, all the data were entered into the SPSS-24 statistical analysis program and authors analyzed the data according to the type of variables by statistical tests.

**Results:** In this study, 50 neonates with seizure were enrolled in this study, 70% of which had an average age of 14.92 days. 80% of infants were born at the time of term. The average birth weight was 3.208 kg. 6.2% of infants had abnormal CT scan findings, with an IVH infant and one baby showing brain edema. In this study, only 14% of neonates with abnormal brain strain were observed in the neonatal period and near the seizure. However, after 3 months, 40% of infants experienced abnormal brain stroke findings. Among the changes in EEG with age ( $p=0.173$ ), gestational age ( $p=0.616$ ), gender ( $p=0.176$ ), seizure ( $p=0.145$ ), neonatal hypoglycemia ( $p=0.594$ ), hypocalcaemia ( $p=0.607$ ) no statistic was found.

**Conclusions:** The results of this study showed that a small percentage of neonates had abnormal EEG in the neonate, but after 3 months of seizure, the larger percentage of them found abnormal EEG.

**Keywords:** Electroencephalography, Neonatal, Seizure

## INTRODUCTION

Seizures are one of the most common problems in neonates and sometimes it's the first symptom of neurological dysfunction in neonates with a prevalence of 1.4-8.6 per 1000 live births.<sup>1-5</sup> In most cases, neonatal seizures improve by age, but in 25% to 35% of cases, neurological developmental defects persist.<sup>6</sup> Neonatal seizures develop due to various causes such as hypoxic-

ischemic encephalopathy, central nervous system infection, intracranial hemorrhage, brain structural abnormalities, and metabolic disorders that among them, hypoxic-ischemic encephalopathy is the most common cause and accounts for 50-75% of all causes.<sup>1</sup> In most cases, the diagnosis of neonatal seizures is based on history, direct observation, and para-clinical findings, and in the absence of timely diagnosis and treatment, it can be associated with increased mortality and persistent

neurological complications.<sup>7-9</sup> Prognostic factors for neonatal seizures include seizure characteristics, prenatal factors, neurological symptoms, causative factors, laboratory studies, and EEG abnormalities that are the most common prognostic factors in the etiology of cerebral seizures.<sup>6,10</sup> Electroencephalography is the recording of the brain's electrical activity. This technique involves obtaining the signal from the surface electrodes, amplifying the signal, printing the signal, and analyzing it. Unlike older children and adults, infants do not always have clear clinical signs during seizures, so EEG is the only available method to diagnose seizures in infants.<sup>8-9</sup>

Since the baby's brain is growing and developing in the first three months of life, so, evaluation of neurological-developmental status in the infants is important and if the EEG study would be normal at the first three months of life the administered anticonvulsant drugs can be discontinued at this age.<sup>11-13</sup> This study aimed to comparison of EEG changes in neonatal period and three months of age in patients with history of neonatal seizure.

## METHODS

This descriptive-analytical study was performed on 50 neonates less than one-month years old with seizures admitted in Bu-Ali Hospital in Ardabil in 2017.

### Exclusion criteria

- The deceased infants during follow-up and who without parental consent to participate in the study were excluded from the study.

### Data collection

Required data were collected through checklists including maternal gestational age, neonatal age at the time of convulsion, neonate's birth weight, serum level of calcium and blood glucose in neonates. EEG was obtained at the time of seizure occurrence and three months later. Total serum calcium levels were considered

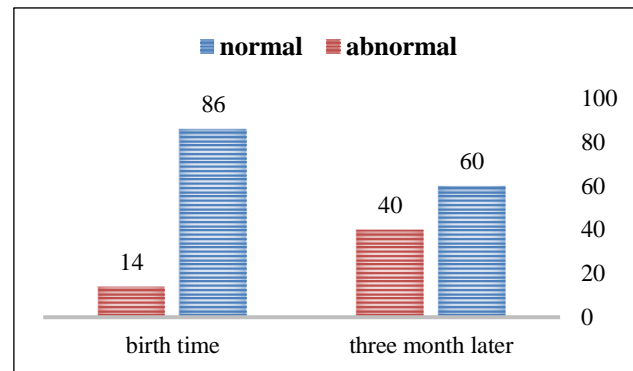
to be between 7.6-10 mg / dL and glucose levels between 40-140 mg / dL.

### Statistical analysis

The collected data were analyzed using descriptive and analytical statistical methods in SPSS 24. p values less than 0.05 was considered as statistically significant.

## RESULTS

Of all neonates, 86% had normal and 14% abnormal EEG, but at three-month-old ones, the number of abnormal EEG cases was 40% high and statistically significant ( $p=0.001$ ) (Figure 1). 70% of neonates were boy and 30% were girls and 26.7% of girls and 8.6% of boys had abnormal EEG with no significant difference. Of neonates, 88% were term and 12% were preterm. Of term neonates 13.6% and 16.7% of preterm neonates had abnormal EEG with no significant difference.



**Figure 1: Frequency of EEG changes in onset time of seizure and three month later.**

The mean age of neonates was  $14.92 \pm 8.62$  days and the mean neonatal birth weight was  $3208 \pm 515$  gr.

**Table 1: Relation between EEG changes with gestational age, sex and causes of seizure.**

Parameters		EEG changes				Total		p-value
		Normal		Abnormal				
		n	%	n	%	n	%	
Gestational age	Preterm	5	83/3	1	16/7	6	12	0.62
	Term	38	86/4	6	13/6	44	88	
Gender	Boy	32	91/4	3	8/6	35	70	0.18
	Girl	11	73/3	4	26/7	15	30	
Causes of seizure	Hypoglycemia	11	84/6	2	15/4	13	26	0.15
	Hypocalcemia	8	100	0	0	8	16	
	Cerebral problems	0	0	1	100	1	2	
	Infection diseases	3	100	0	0	3	6	
	Unknown	21	84	4	16	25	50	

**Table 2: Relation between EEG changes with mean of age, hypoglycemia and hypocalcemia.**

Parameters	EEG changes	N	Mean±SD	p-value
Age of neonates	Normal	43	14.8±8.5	0.17
	Abnormal	7	15.4±9.2	
Hypoglycemia	Abnormal	43	78.05±40.9	0.61
	Abnormal	7	86.9±46.9	
Hypocalcemia	Abnormal	43	8.83±1.61	0.57
	Abnormal	7	8.47±0.81	

The causes of seizures were unknown in 50% of neonates and the most common cause was hypoglycemia in 26% of cases, of which 15.4% had abnormal EEG. There was no significant relationship between the cause of seizure and EEG changes in neonates (Table 1).

The mean of serum glucose level in neonates with abnormal EEG changes was higher than neonates with normal EEG but there was no statistically significant difference. Also, there was no significant relationship between the mean neonates' serum level of calcium and EEG changes at the time of seizure.

The comparison of neonatal age in the two normal and abnormal EEG groups showed that the mean age of neonates with abnormal EEG was higher than mean age of neonates with normal EEGs, but difference wasn't significant (Table 2).

## DISCUSSION

In this study, most of the neonates were male and with a mean age of 14.92 days. In the study of Fallah et al, 60% of neonates were male, and in the study of Dehdashtian and colleagues, 53% of neonates were male with a mean age of 12 days.<sup>11,12</sup> In the study of Abbaskhanian et al, 56.8% of boys had a mean age of 13.4 days.<sup>13</sup> The results of above studies show that the male gender is more common in neonates with seizure which are in line with the present study. In the present study, 88% of neonates had a mean birth weight of 3.208 kg. In the study of Najeeb et al, 90% of neonates were full-term and the mean birth weight of them was 2.56 kg.<sup>14</sup> In the study of Yıldız et al. The mean birth weight was 2633 g and mean gestational age was 36.3 weeks.<sup>15</sup> In a study by Shahraki, the mean birth weight of neonates was 2995.2 gr and 65% of them were term.<sup>16</sup> As seen in the above studies, most neonates with seizure were premature and had low birth weight, which may be due to cerebral lesions including ICH, IVH and ischemic lesions. However, in the present study, the prevalence of preterm neonates was low and none of them were LBW. The study found that 14% of neonates had abnormal EEG, while three months after seizure only 40% of infants had abnormal EEGs. Koelfen stated in his study that changes in the EEG of neonatal seizures are focal slowing at first, and later become in the form of sharp waves or local voltage

drop.<sup>17</sup> Another study by Clancy showed that the EEG indicated the presence and location of brain structural damage in all the patients he had examined.<sup>18</sup> The study of Ashrafzadeh et al reported that abnormal findings were observed in the interictal EEG of 39% of the patients under study, which almost all of the cases with concurrent seizures had an abnormality in EEG.<sup>19</sup>

Almubarak et al in a study reported that 57% of neonates with seizures had an abnormal EEG background.<sup>20</sup> Anand et al also reported in a study that 43% of neonates with seizures had abnormal EEG findings.<sup>21</sup> Pisani also stated in his study that EEG findings were abnormal in 38% of neonates after seizure diagnosis.<sup>22</sup> The above studies show that a high percentage of neonates had abnormal EEGs which is not in line with the present study because the percentage of abnormal EEGs in the present study was lower than the above studies, which may be due to several reasons, including lack of definitive diagnosis of seizures in many neonates of present study, the absence of cerebral lesions in the majority of neonates, the idiopathic seizures and electrolyte disorders which may show a normal EEG in first time.

Metabolic disorders, including disorders of glucose, calcium and magnesium, can cause neurological manifestations. In this study, no correlation was found between neonatal hypoglycemia or hypocalcemia with abnormal EEG findings. But the study by Ashrafzadeh et al. reported that 13% of seizures were due to hypoglycemia and 13% due to other metabolic disorders.<sup>19</sup> In a study by Abbaskhanian et al, the most common cause of seizure was hypoxic-ischemic encephalopathy and in the study by Seyed-shahabi et al, 16% of seizures were due to ischemic cerebral lesions but in the present study, there was no relationship between EEG findings and the causes of seizures.<sup>13,23</sup>

## CONCLUSION

The results of this study showed that a small number of neonates with neonatal seizures had abnormal EEG findings but after three months of seizure, had higher abnormal findings, so a higher sample-sized study is recommended to investigate the causes of the increase in abnormal EEG findings percentage in breastfeeding period along with the causes that affect seizures in the future.

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